

# The Importance of the Salton Sea and Other Terminal Lakes in Supporting Birds of the Pacific Flyway

Terminal lakes, so called because they have no outlet, are characteristic water features of the Great Basin of the Intermountain West. Through the process of continued evaporation, minerals and salts that flow into these water bodies are retained and concentrated over time. The salinity of the water varies considerably among terminal lakes, depending on the quality of the source water and the length of time the lake has been in existence. Several of these, including the Great Salt Lake, Mono Lake, and the Salton Sea, have become more saline than the ocean. While all of these lakes support unique physical characteristics and aquatic ecosystems, one characteristic common to all is the importance they play in sustaining birds using the Pacific Flyway and portions of the Central Flyway.

## Physical and Biological Characteristics of Terminal Lakes in the West

Terminal lakes along the Pacific Flyway (Exhibit 1) vary widely in their physical and biological characteristics. Elevations range from 6,381 feet at Mono Lake to -227 feet at the Salton Sea. They also vary greatly in depth and salinity, as shown in Exhibits 2 and 3. Most of these lakes are shallow with seasonal water input and high evaporation in the summer. Water quality is typically characterized by hard water and saline conditions, an artifact of dissolved constituents accumulating and increasing in concentration over time. While water quality in terminal lakes limits the diversity of the aquatic community to salt-tolerant organisms, these lakes often are very productive, and provide an ample food supply for waterbirds.

Fish reproduction is impaired or ceases in lakes with salinity above 40-45 grams per liter (g/L), and fish cannot survive in lakes with salinity above 50 to 60 g/L (Jehl 1994), although fish may survive in lower salinity areas adjacent to freshwater inflows. Fish diversity in lakes such as Honey, Goose, Pyramid, Carson, Walker, Summer, and Abert, is relatively low and limited to species with high tolerances to dissolved solids and salinity. In lakes with salinity levels too high to support fish, such as Mono Lake, algae serve as the foundation of the food chain, supporting brine flies and brine shrimp, which in turn are consumed by birds.

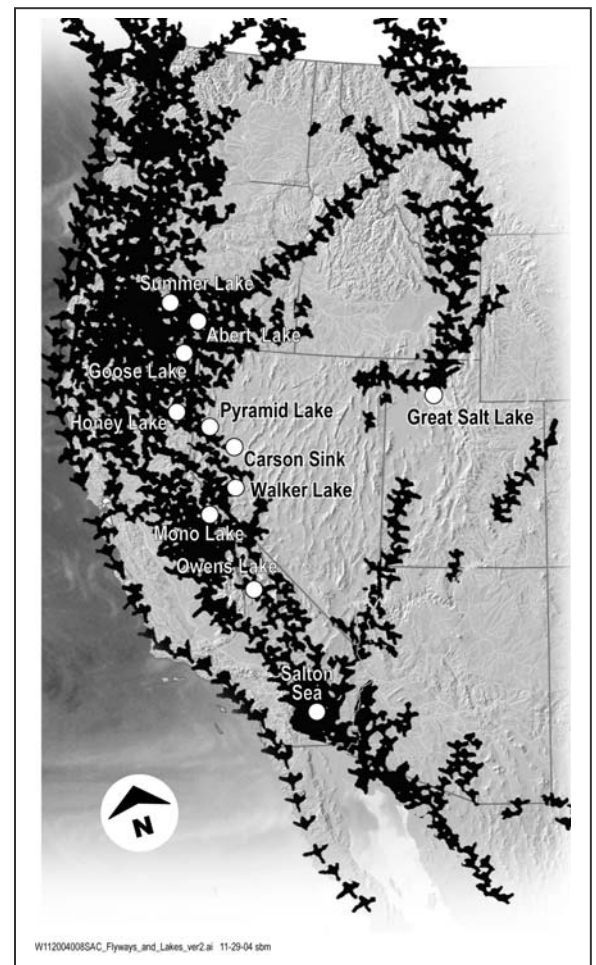
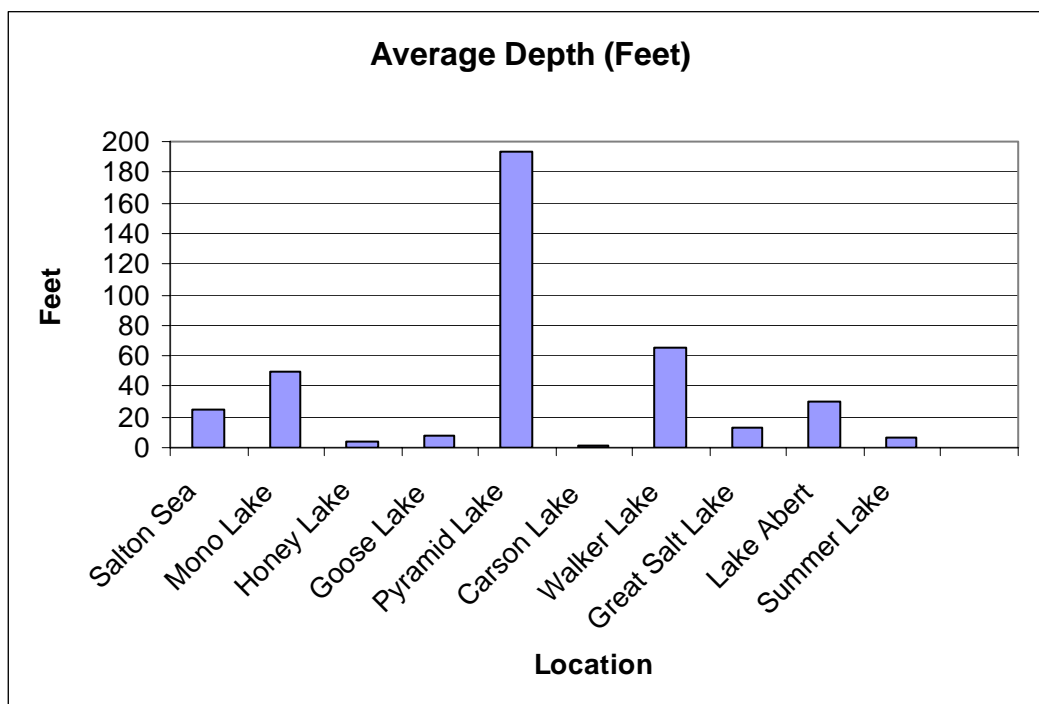
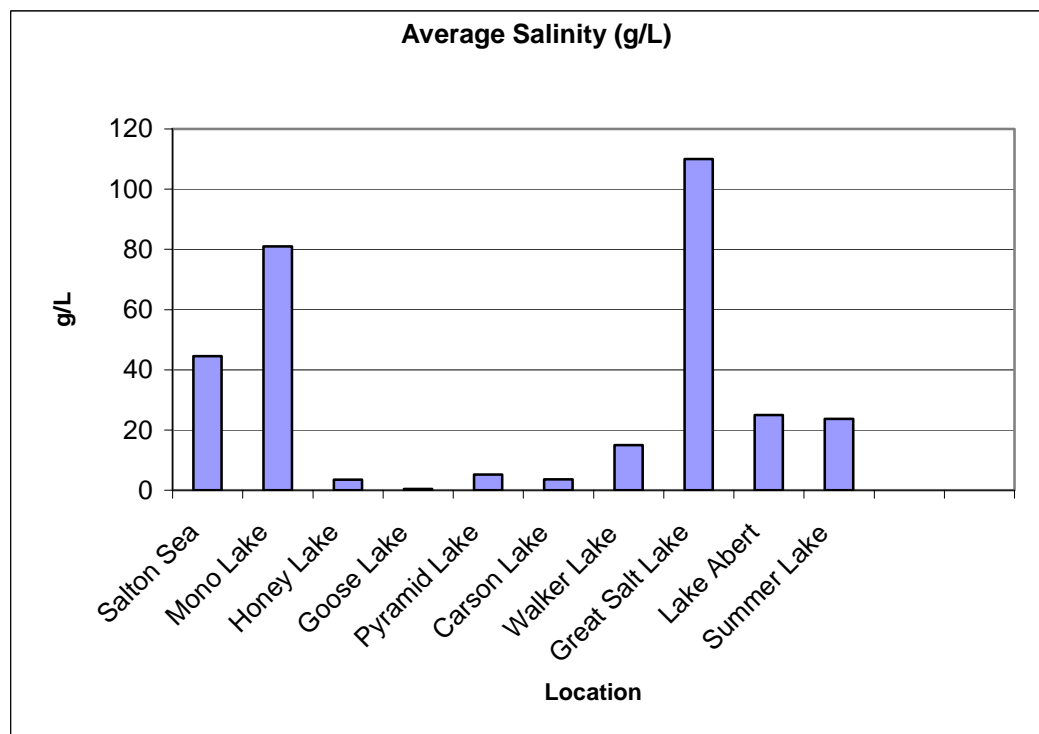


EXHIBIT 1  
Important Terminal Lakes along the Pacific Flyway



**EXHIBIT 2**

Average Depth of Selected Terminal Lakes along the Pacific Flyway



**EXHIBIT 3**

Average Salinity of Selected Terminal Lakes along the Pacific Flyway

# Importance of Terminal Lakes to Birds Using the Pacific Flyway

Millions of birds migrate annually along the Pacific Flyway, one of four flyways in North America. During the spring and fall, terminal lakes are wetland oases that provide essential resting, feeding, and nesting areas for migratory birds.

Some common shorebird species using terminal lakes along the Pacific Flyway include:

<b>Migrant Shorebirds<sup>a</sup></b>	<b>Breeding Shorebirds</b>
American Avocet	American Avocet <sup>b</sup>
Black-necked Stilt	Black-necked Stilt <sup>b</sup>
Least Sandpiper	Common Snipe
Long-billed Dowitcher	Killdeer
Marbled Godwit	Long-billed Curlew <sup>b</sup>
Red-necked Phalarope	Snowy Plover <sup>b</sup>
Western Sandpiper	Spotted Sandpiper
Wilson's Phalarope	Willet
	Wilson's Phalarope <sup>b</sup>

<sup>a</sup> This is a listing of the most numerous migrants and does not include all species

<sup>b</sup> Pacific Flyway habitat is important to maintaining continental populations of these species



*Snowy Plover*

Because of their size and abundance of food, several of these terminal lakes are particularly important to shorebirds and other waterbirds. Of particular note are the Great Salt Lake, Mono Lake, and the Salton Sea.

The Great Salt Lake is the largest of the lakes (932 mi<sup>2</sup>) and supports the highest number of migrant waterbirds. There is overlap in use of the Great Salt Lake by migratory birds in the Pacific Flyway and a portion of the Central Flyway. The high salinity and lack of in-lake predators allows production of large populations of brine shrimp and brine flies upon which birds feed. In addition, wetlands surrounding the Great Salt Lake provide important waterbird habitat (Oring et al. 2004).

Mono Lake (69 mi<sup>2</sup>) also has high salinity, lacks in-lake predators, and supports large populations of brine shrimp and brine flies. It is a vital breeding area for California gulls and snowy plovers, and an important migratory stopover for eared grebes, Wilson's and red-necked phalarope, and ruddy ducks (Oring et al. 2004).

The Salton Sea is the second largest (380 mi<sup>2</sup>) and lowest in salinity of these three lakes. The Salton Sea is unique in its location, acting as a northern extension of the Gulf of California (Jehl 1994, Patten et al. 2003). The food base is abundant and distinctive in that the dominant species are pile worms and fish. Additionally, it is one of the few terminal lakes providing habitat for waterbirds year round.

In addition to these lakes, Owens Lake historically supported large bird populations. Owens Lake is now mostly dry playa, and habitat is limited to wet areas supported by artesian wells and areas that are subjected to shallow flooding for dust control. Some flooded areas are managed for brine fly production and are highly productive. These areas have become important breeding areas for snowy plovers (Oring et al. 2004), and since shallow flooding for dust control began, waterbird use has been increasing in all seasons.

Eared grebe, Wilson's phalarope, American avocet, snowy plover, and California gull are species closely associated with the saline environments found in the Great Salt Lake, Mono Lake, and Salton Sea. Seasonal use of selected terminal lakes by waterbirds using the Pacific Flyway is shown in Exhibit 4 and comparative seasonal shorebird diversity and abundance for terminal lakes along the Pacific Flyway are presented in Exhibit 5 and Exhibit 6, respectively.

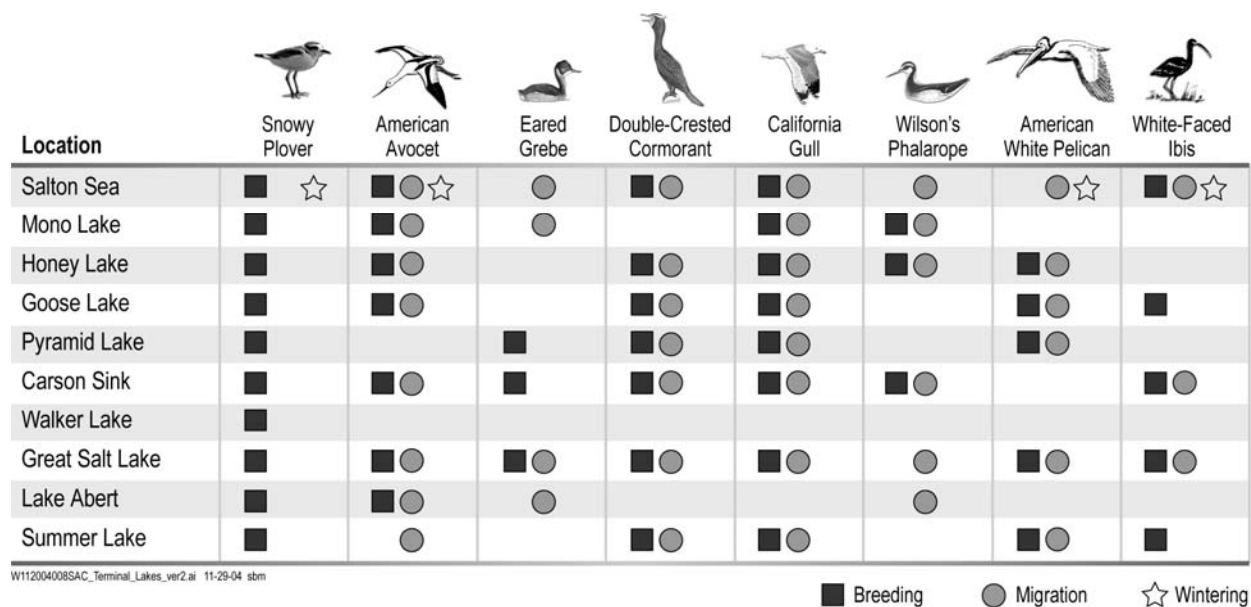
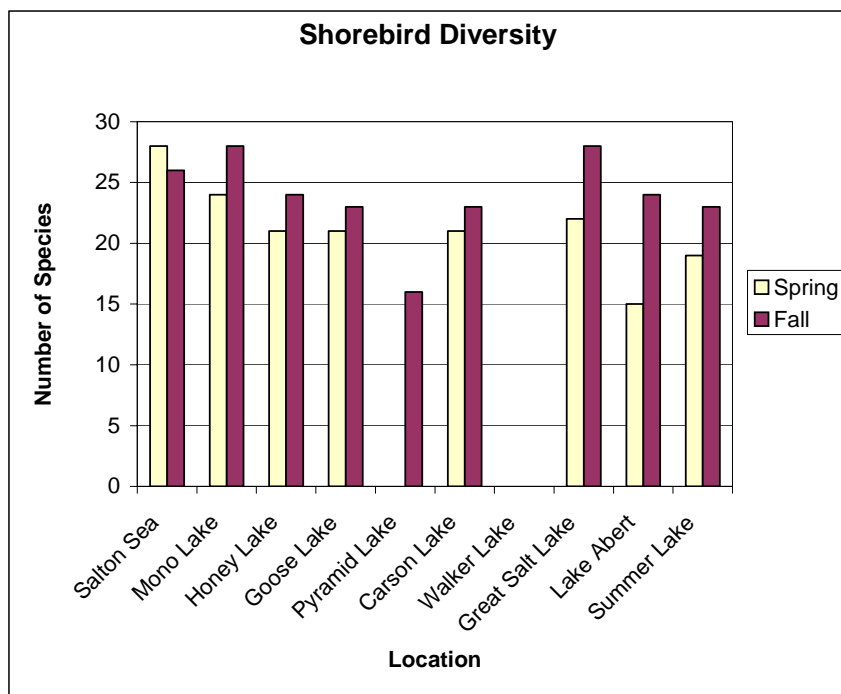


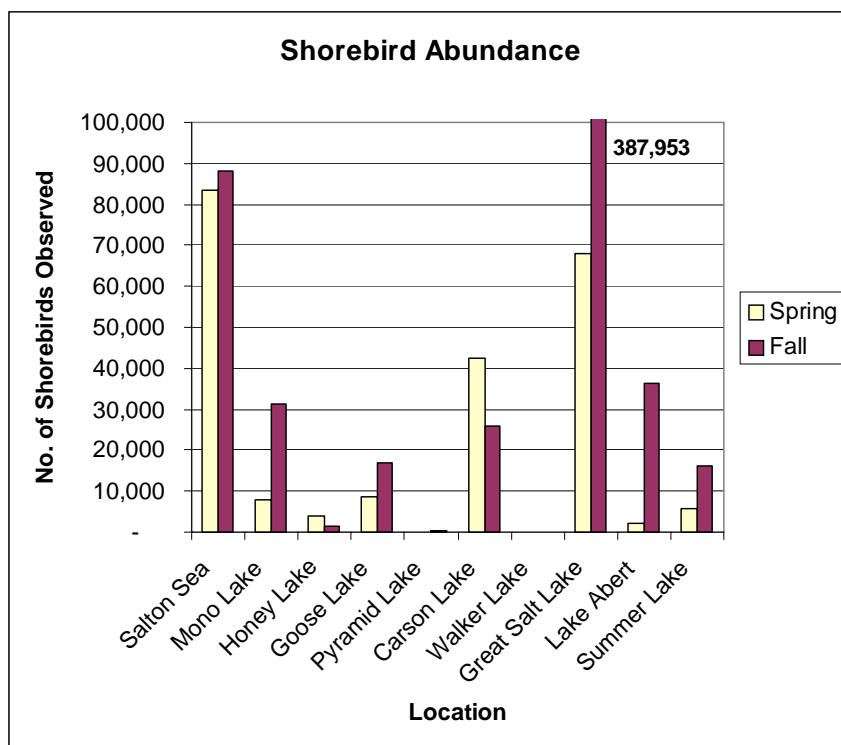
EXHIBIT 4  
Seasonal Use of Terminal Lakes by Species

In addition to shorebirds, terminal lakes that support fish populations along the Pacific Flyway provide important foraging habitat for fish-eating birds including pelicans, cormorants, grebes, gulls, and terns. Many fish-eating species rely on open water habitat for sighting and capturing their prey.

Pyramid Lake and Great Salt Lake are especially important for American white pelican breeding, and support some of the largest pelican colonies in the United States. The Great Salt Lake only supports fish in fresher water areas at the margins of the lakes, and pelicans fly great distances to feed. These lakes and the Salton Sea also support large populations of double-crested cormorants and provide feeding opportunities for other fish-eating birds.



**EXHIBIT 5**  
Comparison of Shorebird Diversity at Selected Terminal Lakes  
(from Shuford et al. 2002)



**EXHIBIT 6**  
Comparison of Shorebird Abundance at Selected Terminal Lakes  
(from Shuford et al. 2002)

Waterfowl (e.g., ducks and geese) also use terminal lakes, but their use is generally focused on adjacent natural and managed freshwater wetlands, with the exception of ruddy ducks and northern shovelers that forage in large numbers at terminal lakes. Wetlands are scarce in the Intermountain West, and terminal lakes and their associated wetland habitats are important for breeding, migrating, and wintering waterfowl.

## Importance of the Salton Sea to Pacific Flyway Waterbirds

The Salton Sea ranks second to Great Salt Lake in its regional importance to shorebirds. It is only one of three sites, along with the Central Valley of California and the Willamette Valley of



*Black-necked Stilt*

Oregon, where tens of thousands of shorebirds winter (Shuford et al. 2004). The Salton Sea is unique among the terminal lakes because of its southern location and low elevation. Consequently, it is productive and used by birds all year. Numerous species of resident, migratory, and special-status birds use the Salton Sea. For several species, the Salton Sea supports a significant portion of the regional or North American populations. For example, an estimated 75 percent of the New World population of eared grebes have been recorded at the Salton Sea (Patten et al. 2003). In addition, 23 to 30 percent of the North American breeding

population of American white pelicans (Shuford et al. 2000), 50 percent of the winter population of ruddy ducks (Patten et al. 2003), and 40 percent of the California breeding population of black skimmers have been recorded at the Salton Sea (Collins and Garrett 1996). The nesting colony of gull-billed terns is the largest in the western United States (Molina 2000).

The Salton Sea provides a stopover and refueling point in Southern California for migrating birds. Approximately 28,000 shorebirds use the Salton Sea during the winter, including species such as American avocets, long-billed dowitchers, black-necked stilts, and western sandpipers (Shuford et al. 2004). The Salton Sea also is a major wintering ground for over 100,000 waterfowl including ruddy ducks, northern shovelers, northern pintails, and Ross and snow geese (Barnum and Johnson 2004).

The Salton Sea functions as a component of the system of lakes and wetlands in the West that support bird life, and most bird species are dependent upon the system as a whole rather than individual lakes. As such, bird use at the Salton Sea is influenced by factors and conditions at other lakes and areas along the Pacific Coast, as well as conditions at the Salton Sea itself.

# Persistence of Terminal Lakes along the Pacific Flyway

Water diversions, drought, and degradation of water quality from excess nutrients and increasing salinity threaten many of the terminal lakes along the Pacific Flyway. Poor conditions at one or more lakes have a ripple effect on the number of birds that can be supported during any given year. In some cases, poor habitat quality at one lake is offset through improved conditions at another, although many of these systems are susceptible to the same threats. The effect of these threats (either individually or cumulatively) puts stress on the aquatic food webs upon which waterbirds depend. Maintaining the number and quality of terminal lakes in the Intermountain West is an important factor in maintaining healthy and sustainable populations of waterbirds in the Pacific Flyway.



*American Avocet*

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